3.4 AGING MANAGEMENT OF STEAM AND POWER CONVERSION SYSTEM

Review Responsibilities

Primary - Branches assigned responsibility per SRP-LR section 3.0

3.4.1 Areas of Review

This review plan section addresses the Aging Management Review (AMR) of the steam and power conversion system for license renewal. For a recent vintage plant, the information related to the steam and power conversion system is contained in Chapter 10, "Steam and Power Conversion System," of the plant's FSAR, consistent with the "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (NUREG-0800) (Ref. 1). The steam and power conversion systems contained in this review plan section are generally consistent with those contained in NUREG-0800 except for the condenser circulating water and the condensate storage systems. For older plants, the location of applicable information is plant-specific because their FSAR may have predated NUREG-0800. Typical steam and power conversion systems that are subject to an AMR for license renewal are steam turbine, main steam, extraction steam, feedwater, condensate, steam generator blowdown (PWR), and auxiliary feedwater (PWR). The aging management for the steam generator is reviewed following the guidance in section 3.1 of this standard review plan. The aging management for portions of the BWR main steam and main feedwater systems, extending from the reactor vessel to the outermost containment isolation valve, is reviewed separately following the guidance in Section 3.1 of this standard review plan.

The responsible review organization is to review the following LRA AMR and AMP items, assigned to it, per SRP-LR section 3.0, for review:

AMRs

- AMRs consistent with the GALL report, for which further evaluation is not recommended
- AMRs consistent with the GALL report, for which further evaluation is recommended
- AMRs not consistent with the GALL report

AMPs

- AMPs consistent with GALL AMPs
- Plant-specific AMPs

FSAR Supplement

- In addition, the responsible review organization is to review the FSAR supplement associated with each assigned AMP.

3.4.2 Acceptance Criteria

The acceptance criteria for the areas of review describe methods for determining whether the applicant has met the requirements of the NRC's regulations in 10 CFR 54.21.

3.4.2.1 AMR Results Consistent with the GALL Report for Which No Further Evaluation is Recommended

The aging management review and acceptable aging management programs applicable to the steam and power conversion system are described and evaluated in Chapter VIII of the GALL report (Ref. 2).

The applicant's LRA should provide sufficient information so that the NRC reviewer is able to confirm that the specific AMR line-item and the associated AMP are consistent with the cited GALL AMR line-item. The staff reviewer should then confirm that the LRA AMR line-item is consistent with the GALL line-item to which it is compared.

If the applicant identifies an exception to the cited GALL AMP, the LRA should include a basis or reference how the criteria of 10 CFR 54.21(a)(3) would still be met. The NRC reviewer should then confirm that the AMP with all exceptions would satisfy the criteria of 10 CFR 54.21(a)(3). If, while reviewing the AMP, the reviewer identifies a difference from the GALL AMP, this difference should be reviewed and dispositioned as if it was an exception identified by the applicant in its LRA. The disposition of all LRA-defined exceptions and staff-identified differences should be documented.

The LRA should identify any enhancements that are needed to permit an existing aging management program to be declared consistent with the GALL AMP to which the LRA AMP is compared. The reviewer is to confirm both that the enhancement, if implemented, would allow the existing plant aging management program to be consistent with the GALL AMP and also that the applicant has a commitment to implement the enhancement prior to the period of extended operation. The reviewer should document the disposition of all enhancements.

3.4.2.2 AMR Results Consistent with the GALL Report for Which Further Evaluation is Recommended

The basic acceptance criteria defined in 3.4.2.1 apply to all of the AMRs and AMPs reviewed as part of this section. In addition, if the GALL AMR line-item to which the LRA AMR line-item is compared identifies that "further evaluation is recommended," then additional criteria apply as identified by the GALL report for each of the following aging effect/aging mechanism combinations.

3.4.2.2.1 Cumulative Fatigue Damage

Fatigue is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed separately in Section 4.3 of this standard review plan.

3.4.2.2.2 Loss of Material due to General and/or Pitting, and Crevice Corrosion

For components exposed to a treated water environment (except for certain main steam system components), the management of loss of material due to general, pitting, and crevice corrosion should be evaluated further for steel piping, piping components, and piping elements, tanks, and heat exchanger shell-side components and for loss of material due to pitting and crevice corrosion for stainless steel tanks and heat exchanger shell-side components. The water chemistry program relies on monitoring and control of water chemistry based on the guidelines

in BWRVIP-29 (EPRI TR-103515) (Ref. 3) for water chemistry in BWRs and EPRI guidelines of TR-102134 (Ref. 4) for secondary water chemistry in PWRs to manage the effects of loss of material due to general, pitting, or crevice corrosion. However, corrosion may occur at locations of stagnant flow conditions. Therefore, the effectiveness of the chemistry control program should be verified to ensure that corrosion is not occurring. The GALL report recommends further evaluation of programs to manage loss of material due to general, pitting, and crevice corrosion to verify the effectiveness of the water chemistry program. A one-time inspection of select components and susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

3.4.2.2.3 Loss of Material due to General, Pitting, Crevice and Microbiologically Influenced Corrosion, and Macrofouling due to Biofouling

Loss of material due to general, pitting, crevice, and microbiologically influenced corrosion (MIC), and macrofouling due to biofouling could occur in steel piping, piping components, and piping elements for untreated water from the backup water supply in the PWR auxiliary feedwater system. The GALL report recommends further evaluation to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1, of this standard review plan.)

3.4.2.2.4 General Corrosion

Loss of material due to general corrosion could occur on the external surfaces of all steel structures and components, including closure bolting,. The GALL report recommends further evaluation to ensure that this aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1, of this standard review plan.)

3.4.2.2.5 Loss of Material due to General, Pitting, Crevice, and Microbiologically Influenced Corrosion

1. Loss of material due to general corrosion (steel only), pitting and crevice corrosion, and MIC could occur in stainless steel and steel shells, tubes, and tubesheets within the bearing oil coolers (for steam turbine pumps) in the PWR auxiliary feedwater system. The GALL report recommends further evaluation to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1, of this standard review plan.)

2. Loss of material due to general corrosion, pitting and crevice corrosion, and MIC could occur in underground piping, piping components, piping elements and tanks. The buried piping and tanks inspection program relies on industry practice, frequency of pipe excavation, and operating experience to manage the effects of loss of material from general corrosion, pitting and crevice corrosion, and MIC. The effectiveness of the buried piping and tanks inspection program should be verified to evaluate an applicant's inspection frequency and operating experience with buried components, ensuring that loss of material is not occurring.

3.4.2.2.6 Cracking due to Stress Corrosion Cracking

Cracking due to SCC could occur in the stainless steel piping, piping components, and piping elements and in stainless steel heat exchanger tube-side components (including the tubes) exposed to treated water and steam. The water chemistry program relies on monitoring and control of water chemistry based on the guidelines in BWRVIP-29, BWR Water Chemistry Guidelines TR-103515 (Ref. 3) and TR-102134, PWR Secondary Water Chemistry Guideline (Ref.4) to manage the effects of cracking due to SCC. However, high concentrations of impurities at crevices and locations of stagnant flow conditions could cause SCC. Therefore, the GALL report recommends verification of the effectiveness of the chemistry control program should be performed to ensure that SCC is not occurring. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that stress corrosion cracking is not occurring and that the component's intended function will be maintained during the period of extended operation.

3.4.2.2.7 Quality Assurance for Aging Management of Nonsafety-Related Components

Acceptance criteria are described in Branch Technical Position IQMB-1 (Appendix A.2 of this standard review plan.)

3.4.2.3 AMR Results Not Consistent with or Not Addressed in GALL Report

Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1, of this standard review plan.)

3.4.2.4 FSAR Supplement

The summary description of the programs and activities for managing the effects of aging for the period of extended operation in the FSAR supplement should be appropriate such that later changes can be controlled by 10 CFR 50.59. The description should contain information associated with the bases for determining that aging effects will be managed during the period of extended operation. The description should also contain any future aging management activities, including enhancements, to be completed before the period of extended operation. Examples of the type of information required are provided in Table 3.4-2 of this standard review plan.

3.4.3 Review Procedures

For each area of review, the following review procedures are to be followed:

3.4.3.1 AMR Results Consistent with the GALL Report for Which No Further Evaluation is Recommended

The applicant may reference the GALL report in its license renewal application, as appropriate, to demonstrate that the aging management reviews and programs at its facility are consistent with those reviewed and approved in the GALL report. The reviewer should not conduct a re-review of the substance of the matters described in the GALL report. If the applicant has provided the information necessary to adopt the finding of program acceptability as described and evaluated in the GALL report, the staff should find acceptable the applicant's reference to GALL in its license renewal application. In making this determination, the reviewer confirms that the applicant has provided a brief description of the system, components, materials, and environment. The reviewer also confirms that the applicant has stated that the applicable aging effects and industry and plant-specific operating experience have been reviewed by the applicant and are evaluated in the GALL Report.

Furthermore, the reviewer should confirm that the applicant has addressed operating experience identified after the issuance of the GALL report. Performance of this review requires the reviewer to confirm that the applicant has identified those aging effects for the steam and power conversion system components that are contained in GALL as applicable to its plant.

The reviewer confirms that the applicant has identified the appropriate AMPs as described and evaluated in the GALL report. If the applicant commits to an enhancement to make its aging management program consistent with a GALL AMP, then the reviewer is to confirm that this enhancement when implemented will indeed make the LRA AMP consistent with the GALL AMP. If an aging management program in the LRA identifies an exception to the GALL AMP to which it is claiming to be consistent, the reviewer is to confirm that the LRA AMP with the exception will satisfy the criteria of 10CFR54.21(a)(3). If the reviewer identifies a difference, not identified by the LRA, between the LRA AMP and the GALL AMP, to which the LRA claims to be consistent, the reviewer should confirm that the LRA AMP with this difference satisfies 10CFR54.21(a)(3). The reviewer should document the basis for accepting enhancements, exceptions or differences. The AMPs evaluated in GALL pertinent to the steam and power conversion system components are summarized in Table 3.4-1 of this standard review plan.

3.4.3.2 AMR Results Consistent with the GALL Report for Which Further Evaluation is Recommended

The basic review procedures defined in 3.4.3.1 apply to all of the AMRs and AMPs provided in this section. In addition, if the GALL AMR line-item to which the LRA AMR line-item is compared identifies that "further evaluation is recommended," then additional criteria apply as identified by the GALL report for each of the following aging effect/aging mechanism combinations.

3.4.3.2.1 Cumulative Fatigue Damage

Fatigue is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The staff reviews the evaluation of this TLAA separately following the guidance in Section 4.3 of this standard review plan.

3.4.3.2.2 Loss of Material due to General, Pitting, and Crevice Corrosion

For components exposed to a treated-water environment (except for certain main steam system components), the GALL report recommends further evaluation of programs to manage loss of material due to general, pitting, and crevice corrosion of steel piping, piping components, and piping elements, tanks, and heat exchanger shell-side components,, and for loss of material due to pitting and crevice corrosion for stainless steel tanks and heat exchanger shell-side components to verify the effectiveness of the water chemistry program. An acceptable verification program consists of a one-time inspection of select components and susceptible locations in the system. The water chemistry program relies on monitoring and control of water chemistry based on BWRVIP-29 (EPRI TR-103515) (Ref. 3) for water chemistry in BWRs and EPRI guidelines of TR-102134 (Ref. 4) for secondary water chemistry in PWRs to manage the effects of loss of material due to general, pitting, or crevice corrosion. However, corrosion may occur at locations of stagnant flow conditions. Therefore, the effectiveness of the chemistry control program should be verified to ensure that significant degradation is not occurring and that the component's intended function will be maintained during the period of extended operation.

The staff reviews the applicant's proposed program to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation. If an applicant proposes a one-time inspection of select components and susceptible locations to ensure that corrosion is not occurring, the reviewer verifies that the applicant's selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. The reviewer also verifies that the proposed inspection would be performed using techniques similar to ASME Code and ASTM standards.

3.4.3.2.3 Loss of Material due to General, Pitting, Crevice, and Microbiologically Influenced Corrosion, and Macrofouling due to Biofouling

The GALL report recommends further evaluation of programs to manage the loss of material due to general, pitting, crevice, and microbiologically influenced corrosion, and to manage macrofouling due to biofouling for steel piping, piping components, and piping elements for untreated water from the backup water supply in the PWR auxiliary feedwater system. Such corrosion may be due to untreated water from the backup water supply. The staff reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

3.4.3.2.4 Loss of Material due to General Corrosion

The GALL report recommends further evaluation of programs to manage the loss of material due to general corrosion for external surfaces of all steel structures and components, including closure bolting.. Such corrosion may be due to air, moisture, or humidity. The staff reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

3.4.3.2.5 Loss of Material due to General, Pitting, Crevice, and Microbiologically Influenced Corrosion

1. The GALL report recommends further evaluation of programs to manage the loss of material due to general corrosion (steel only), pitting and crevice corrosion, and MIC for stainless steel and steel shells, tubes, and tubesheets within the bearing oil coolers (for steam-turbine pumps) in the PWR auxiliary feedwater system. Such corrosion may be due to water contamination that affects the quality of the lubricating oil in the bearing oil coolers. The staff

reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

2. The GALL report recommends further evaluation of programs to manage loss of material due to general corrosion, pitting and crevice corrosion, and MIC of underground piping, piping components, piping elements and tanks. The buried piping and tanks inspection program relies on industry practice, frequency of pipe excavation, and operating experience to manage the effects of loss of material from general corrosion, pitting and crevice corrosion, and MIC. The staff reviews the applicant's program, including inspection frequency and operating experience with buried components, to assess the effectiveness of the buried piping and tanks inspection program in ensuring that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

3.4.3.2.6 Cracking due to Stress Corrosion Cracking

The GALL report recommends further evaluation of programs to manage cracking due to SCC of BWR and PWR stainless steel piping, piping components, piping elements, and heat exchanger tube-side components (including the tubes) exposed to treated water and steam. The water chemistry program relies on monitoring and control of water chemistry based on the guidelines in BWRVIP-29, BWR Water Chemistry Guidelines TR-103515 (Ref. 3) and TR-102134, PWR Secondary Water Chemistry Guideline (Ref.4) to manage the effects of cracking due to SCC. The effectiveness of the water chemistry control program should be reviewed to verify that cracking is not occurring and that the component's intended function would be maintained during the period of extended operation.

The reviewer reviews the applicant's proposed program to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation. If the applicant proposes a one-time inspection of select components at susceptible locations to ensure that corrosion is not occurring, the reviewer verifies that the applicant's selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. The reviewer also verifies that the proposed inspection would be performed using techniques similar to ASME Code and ASTM standards, including visual, ultrasonic, and surface techniques (Ref. 6, 7).

3.4.3.2.7 Quality Assurance for Aging Management of Nonsafety-Related Components

An applicant's aging management programs for license renewal should contain the elements of corrective actions, the confirmation process, and administrative controls. Safety-related components are covered by 10 CFR Part 50 Appendix B, which is adequate to address these program elements. However, Appendix B does not apply to nonsafety-related components that are subject to an AMR for license renewal. Nevertheless, an applicant has the option to expand the scope of its 10 CFR Part 50 Appendix B program to include these components and address these program elements. If an applicant chooses this option, the reviewer verifies that the applicant has documented such a commitment in the FSAR supplement. If an applicant chooses alternative means, the branch responsible for quality assurance should be requested to review the applicant's proposal on a case-by-case basis.

3.4.3.3 AMR Results Not Consistent with or Not Addressed in GALL Report

The reviewer should confirm that the applicant, in the license renewal application, has identified applicable aging effects, listed the appropriate combination of materials and environments, and aging management programs that will adequately manage the aging effects. The aging management program credited could be an AMP that is described and evaluated in the GALL report or a plant-specific program. Review procedures are described in Branch Technical Position RLSB-1 (Appendix A.1, of this standard review plan.)

3.4.3.4 FSAR Supplement

The reviewer confirms that the applicant has provided a FSAR supplement for aging management of the steam and power conversion system for license renewal with information equivalent to that in Table 3.4-2 of this review plan section. The reviewer also confirms that the applicant has provided information, equivalent to that in Table 3.4-2, in the FSAR supplement for Subsection 3.4.3.3, "AMR Results Not Consistent with or Not Addressed in GALL Report ."

The staff expects to impose a license condition on any renewed license to require the applicant to update its FSAR to include this FSAR supplement at the next update required pursuant to 10 CFR 50.71(e)(4). As part of the license condition, until the FSAR update is complete, the applicant may make changes to the programs described in its FSAR supplement without prior NRC approval, provided that the applicant evaluates each such change pursuant to the criteria set forth in 10 CFR 50.59.

As noted in Table 3.4-2, the applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should confirm that the applicant has identified and committed in the license renewal application to any future aging management activities to be completed before the period of extended operation. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

3.4.4 Evaluation Findings

The reviewer verifies that the applicant has provided information sufficient to satisfy the provisions of this review plan section and that the staff's evaluation supports conclusions of the following type, to be included in the staff's safety evaluation report:

> On the basis of its review, the staff concludes that the applicant has adequately identified the aging effects and the AMPs credited with managing these aging effects for the steam and power conversion systems, such that there is reasonable assurance that the component intended functions will be maintained consistent with the CLB during the period of extended operation. The staff also reviewed the applicable FSAR supplement program descriptions and concludes that the FSAR supplement provides an adequate program description of the AMPs credited for managing aging effects, as required by 10 CFR 54.21(d).

3.4.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the NRC's regulations, the method described herein will be used by the staff in its evaluation of conformance with NRC regulations.

3.4.6 References

1. NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants,” U.S. Nuclear Regulatory Commission, July 1981.

2. NUREG-1801, “Generic Aging Lessons Learned (GALL),” U.S. Nuclear Regulatory Commission, July 2001.

3. BWRVIP-29, BWR Water Chemistry Guidelines-Revision 3 [EPRI TR-103515], Normal and Hydrogen Water Chemistry, Electric Power Research Institute, Palo Alto, CA, February 1994.

4. EPRI TR-102134, PWR Secondary Water Chemistry Guideline-Revision 3, Electric Power Research Institute, Palo Alto, CA, May 1993.

[Original Table Replaced In Its Entirety Below.]

Table 3.4-1. Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL Report

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	SRP Ref	Item Number in GALL
BWR/ PWR	Piping, piping components, and piping elements	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA (See Subsection 3.4.2.2.1)	3.4.2.2.1	S-08 S-11
BWR/ PWR	Piping, piping components, and piping elements; Tanks, and heat exchanger shell-side components	Loss of material due to General, pitting and crevice corrosion	Water chemistry and one-time inspection	Yes, detection of aging effects is to be evaluated (See Subsection 3.4.2.2.2)	3.4.2.2.2	S-04 S-06 S-09 S-10 S-18 S-19
		Loss of material due to Pitting and crevice corrosion	Water chemistry and one-time inspection	Yes, detection of aging effects is to be evaluated (See Subsection 3.4.2.2.2)	3.4.2.2.2	S-13 S-14 S-21 S-22 S-35 SP-16 SP-21
BWR/ PWR	Piping, piping components, and piping elements	Loss of material due to General, pitting, crevice, MIC and macrofouling due to Biofouling	Plant specific	Yes, plant specific (See Subsection 3.4.2.2.3)	3.4.2.2.3	S-12
BWR/ PWR	External surfaces	Loss of material due to General corrosion	Plant specific	Yes, plant specific (See Subsection 3.4.2.2.4)	3.4.2.2.4	S-29 S-41 S-42
BWR/ PWR	Heat exchanger shell side components	Loss of material due to General, pitting, crevice, and MIC	Plant specific	Yes, plant specific (See Subsection 3.4.2.2.5.1)	3.4.2.2.5.1	S-17
		Loss of material due to Pitting, crevice, and MIC	Plant specific	Yes, plant specific (See Subsection 3.4.2.2.5.1)	3.4.2.2.5.1	S-20

Table 3.4-1. Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL Report

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	SRP Ref	Item Number in GALL
BWR/ PWR	Buried piping, piping components, piping elements, and tanks	Loss of material due to General, pitting, crevice, and MIC	Buried piping and tanks surveillance or Buried piping and tanks inspection	Yes, plant specific (See Subsection 3.4.2.2.5.2)	3.4.2.2.5.2	S-01
BWR/ PWR	Piping, piping components, and piping elements; Heat exchanger tube side components including tubes	Cracking due to Stress corrosion cracking	Water chemistry and one-time inspection	Yes, detection of aging effects is to be evaluated (See Subsection 3.4.2.2.6)	3.4.2.2.6	S-37 S-38 S-39 SP-17 SP-19 SP-20 SP-22
BWR/ PWR	Bolting	Loss of material due to General, pitting and crevice corrosion	Bolting Integrity	No	NA	S-32
	Closure bolting	Cracking due to Cyclic loading, stress corrosion cracking	Bolting Integrity	No	NA	S-03
		Loss of material due to General, pitting and crevice corrosion	Bolting Integrity	No	NA	S-02 S-34
		Loss of preload due to Stress relaxation	Bolting Integrity	No	NA	S-33
	Heat exchanger shell side components	Loss of material due to General, pitting and crevice corrosion	Closed-cycle cooling water system	No	NA	S-23

Table 3.4-1. Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL Report

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	SRP Ref	Item Number in GALL
		Loss of material due to General, pitting, crevice, MIC and macrofouling due to Biofouling	Open-cycle cooling water system	No	NA	S-24 S-26
		Loss of material due to Pitting and crevice corrosion	Closed-cycle cooling water system	No	NA	S-25
	Heat exchanger tubes	Reduction of heat transfer	Open-cycle cooling water system	No	NA	S-28
		Reduction of heat transfer due to biofouling	Open-cycle cooling water system	No	NA	S-27
	Piping, piping components, and piping elements	Loss of material due to Flow-accelerated corrosion	Flow-accelerated corrosion	No	NA	S-15 S-16
		Loss of material due to Pitting and crevice corrosion	Closed-cycle cooling water system	No	NA	SP-08
			Water Chemistry	No	NA	S-05 S-36 SP-18
	Tank	Loss of material due to General corrosion	Aboveground steel tanks	No	NA	S-31
PWR	External surfaces	Loss of material due to Boric acid corrosion	Boric acid corrosion	No	NA	S-30
	Bolting	Loss of material due to Boric acid corrosion	Boric acid corrosion	No	NA	S-40

Table 3.4-1. Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL Report

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	SRP Ref	Item Number in GALL
	Piping, piping components, and piping elements	Loss of material due to Pitting and crevice corrosion	Water Chemistry	No	NA	S-07
BWR/ PWR	Piping, piping components, and piping elements	None	None	NA - No AEM or AMP	NA - No AEM or AMP	SP-01 SP-02 SP-03 SP-04 SP-05 SP-06 SP-07 SP-09 SP-10 SP-11 SP-12 SP-13 SP-14 SP-15

Table 3.4-2. FSAR Supplement for Aging Management of Steam and Power Conversion System

Program	Description of Program	Implementation Schedule*
Bolting integrity (BWR/PWR)	This program consists of guidelines on materials selection, strength and hardness properties, installation procedures, lubricants and sealants, corrosion considerations in the selection and installation of pressure-retaining bolting for nuclear applications, and enhanced inspection techniques. This program relies on the bolting integrity program delineated in NUREG-1339 and industry's recommendations delineated in EPRI NP-5769, with the exceptions noted in NUREG-1339 for safety-related bolting and in EPRI TR-104213 for pressure retaining bolting and structural bolting.	Existing program
Boric acid corrosion (PWR)	The program consists of (1) visual inspection external surfaces that are potentially exposed to borated water leakage, (2) timely discovery of leak path and removal of the boric acid residues, (3) assessment of the damage, and (4) follow-up inspection for adequacy. This program is implemented in response to GL 88-05.	Existing program
Closed-cycle cooling water system (BWR/PWR)	The program relies on preventive measures to minimize corrosion by maintaining inhibitors and by performing non-chemistry monitoring consisting of inspection and nondestructive evaluations based on the guidelines of EPRI-TR-107396 for closed-cycle cooling water systems.	Existing program
Flow-accelerated corrosion (BWR/PWR)	The program consists of (1) conduct appropriate analysis and baseline inspection, (2) determine extent of thinning, and replace/repair components, and (3) perform follow-up inspections to confirm or quantify and take longer-term corrective actions. The program relies on implementation of EPRI guidelines of NSAC-202L-R2.	Existing program
One-time inspection (BWR/PWR)	To verify the effectiveness of the water chemistry control program by determining if the aging effect is not occurring or the aging effect is progressing slowly so that the intended function will be maintained during the period of extended operation, a one-time inspection of internal surfaces of piping, piping components, and piping elements, heat exchangers and tanks is performed using suitable techniques at the most susceptible locations to ensure that the aging effect is not occurring.	The inspection should be completed before the period of extended operation.

Table 3.4-2. FSAR Supplement for Aging Management of Steam and Power Conversion System (continued)

Program	Description of Program	Implementation Schedule*
Open-cycle cooling water system (BWR/PWR)	The program includes (a) surveillance and control of biofouling, (b) tests to verify heat transfer, (c) routine inspection and maintenance program, (d) system walk down inspection, and (e) review of maintenance, operating, and training practices and procedures. The program provides assurance that the open-cycle cooling water system is in compliance with General Design Criteria and Quality Assurance to ensure that the open-cycle cooling water (or service water) system can be managed for an extended period of operation. This program is in response to NRC GL 89-13.	Existing program
Above-ground steel tanks (BWR/PWR)	The program includes preventive measures to mitigate corrosion by protecting the external surface of steel components, per standard industry practice, with sealant or caulking at the interface of concrete and component. Visual inspection during periodic system walk downs should be sufficient to monitor degradation of the protective paint, coating, calking, or sealant. Verification of the effectiveness of the program by measuring the thickness of the tank bottoms ensures that significant degradation is not occurring and that the component intended function will be maintained during the period of extended operation.	Existing program
Buried piping and tanks surveillance (BWR/PWR)	The program includes preventive measures to mitigate corrosion by protecting the external surface of buried piping and components, e.g., coating, wrapping, and a cathodic protection system. The program also includes surveillance and monitoring of the coating conductance versus time or current. This program is based on standard industry practices as described in NACE-RP-01-69.	Existing program
Buried piping and tanks inspection	The program includes (a) preventive measures to mitigate corrosion, and (b) periodic inspection to manage the effects of corrosion on the pressure-retaining capacity of buried steel piping and tanks. Preventive measures are in accordance with standard industry practice for maintaining external coatings and wrappings and cathodic protection. As an alternative, buried piping and tanks are inspected when they are excavated during maintenance and when a pipe is dug up and inspected for any reason with a frequency that is based on operating experience.	Program should be implemented before the period of extended operation.
Plant-specific AMP (PWR)	The description should contain information associated with the bases for determining that aging effects will be managed during the period of extended operation.	Program should be implemented before the period of extended operation.

Table 3.4-2. FSAR Supplement for Aging Management of Steam and Power Conversion System (continued)

Program	Description of Program	Implementation Schedule*
Quality assurance (BWR/PWR)	The 10 CFR Part 50 Appendix B program provides for corrective actions, the confirmation process, and administrative controls for aging management programs for license renewal. The scope of this existing program will be expanded to include nonsafety-related structures and components that are subject to an AMR for license renewal.	Program should be implemented before the period of extended operation.
Water chemistry (BWR/PWR)	To mitigate aging effects on component surfaces that are exposed to water as process fluid, chemistry programs are used to control water impurities (e.g., chloride, fluoride, sulfate) that accelerate corrosion. The water chemistry program relies on monitoring and control of water chemistry based on BWRVIP-29 (EPRI TR-103515) for water chemistry in BWRs and EPRI guidelines of TR-102134 for secondary water chemistry in PWRs.	Existing program

* An applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should verify that the applicant has identified and committed in the license renewal application to any future aging management activities to be completed before the period of extended operation. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

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